

FACT SHEET

U.S. SPACE-BASED POSITIONING, NAVIGATION, AND TIMING POLICY

The President authorized a new national policy on December 8 that establishes guidance and implementation actions for space-based positioning, navigation, and timing programs, augmentations, and activities for U.S. national and homeland security, civil, scientific and commercial purposes. This policy supersedes Presidential Decision Directive/National Science and Technology Council-6, U.S. Global Positioning System Policy, dated March 28, 1996.

I. Scope and Definitions

This policy provides guidance for: (1) development, acquisition, operation, sustainment, and modernization of the Global Positioning System and U.S.-developed, owned and/or operated systems used to augment or otherwise improve the Global Positioning System and/or other space-based positioning, navigation, and timing signals; (2) development, deployment, sustainment, and modernization of capabilities to protect U.S. and allied access to and use of the Global Positioning System for national, homeland, and economic security, and to deny adversaries access to any space-based positioning, navigation, and timing services; and (3) foreign access to the Global Positioning System and United States Government augmentations, and international cooperation with foreign space-based positioning, navigation, and timing services, including augmentations.

For purposes of this document:

- "Interoperable" refers to the ability of civil U.S. and foreign space-based positioning, navigation, and timing services to be used together to provide better capabilities at the user level than would be achieved by relying solely on one service or signal;
- "Compatible" refers to the ability of U.S. and foreign space-based positioning, navigation, and timing services to be used separately or together without interfering with each individual service or signal, and without adversely affecting navigation warfare; and
- "Augmentation" refers to space and/or ground-based systems that provide users of space-based positioning, navigation, and timing signals with additional information that enables users to obtain enhanced performance when compared to the un-augmented space-based signals alone. These improvements include better accuracy, availability, integrity, and reliability, with independent integrity monitoring and alerting capabilities for critical applications.

II. Background

Over the past decade, the Global Positioning System has grown into a global utility whose multi-use services are integral to U.S. national security, economic growth, transportation safety, and homeland security, and are an essential element of the worldwide economic infrastructure. In the year 2000, the United States recognized the increasing importance of the Global Positioning System to civil and commercial users by discontinuing the deliberate degradation of accuracy for non-military signals, known as Selective Availability. Since that time, commercial and civil applications of the Global Positioning System have continued to multiply and their importance has increased significantly. Services dependent on Global Positioning System information are now an engine for economic growth, enhancing economic development, and improving safety of life, and the system is a key component of multiple sectors of U.S. critical infrastructure.

While the growth in civil and commercial applications continues, the positioning, navigation, and timing information provided by the Global Positioning System remains critical to U.S. national security, and its applications are integrated into virtually every facet of U.S. military operations. United States and allied military forces will continue to rely on the Global Positioning System military services for positioning, navigation, and timing services.

The continuing growth of services based on the Global Positioning System presents opportunities, risks, and threats to U.S. national, homeland, and economic security. The widespread and growing dependence on the Global Positioning System of military, civil, and commercial systems and infrastructures has made many of these systems inherently vulnerable to an unexpected interruption in positioning, navigation, and/or timing services. In addition, whether designed for military capabilities or not, all positioning, navigation, and timing signals from space and their augmentations provide inherent capabilities that can be used by adversaries, including enemy military forces and terrorist groups. Finally, emerging foreign space-based positioning, navigation, and timing services could enhance or undermine the future utility of the Global Positioning System.

The United States must continue to improve and maintain the Global Positioning System, augmentations, and backup capabilities to meet growing national, homeland, and economic security requirements, for civil requirements, and to meet commercial and scientific demands. In parallel, we must continue to improve capabilities to deny adversary access to all space-based positioning, navigation, and timing services, particularly including services that are openly available and can be readily

used by adversaries and/or terrorists to threaten the security of the United States. In addition, the diverse requirements for and multiple applications of space-based positioning, navigation, and timing services require stable yet adaptable policies and management mechanisms. The existing management mechanisms for the Global Positioning System and its augmentations must be modified to accommodate a multi-use approach to program planning, resource allocation, system development, and operations. Therefore, the United States Government must improve the policy and management framework governing the Global Positioning System and its augmentations to support their continued ability to meet increasing and varied domestic and global requirements.

III. Goals and Objectives

The fundamental goal of this policy is to ensure that the United States maintains space-based positioning, navigation, and timing services, augmentation, back-up, and service denial capabilities that:

- (1) provide uninterrupted availability of positioning, navigation, and timing services;
- (2) meet growing national, homeland, economic security, and civil requirements, and scientific and commercial demands;
- (3) remain the pre-eminent military space-based positioning, navigation, and timing service;
- (4) continue to provide civil services that exceed or are competitive with foreign civil space-based positioning, navigation, and timing services and augmentation systems;
- (5) remain essential components of internationally accepted positioning, navigation, and timing services; and
- (6) promote U.S. technological leadership in applications involving space-based positioning, navigation, and timing services. To achieve this goal, the United States Government shall:

- Provide uninterrupted access to U.S. space-based global, precise positioning, navigation, and timing services for U.S. and allied national security systems and capabilities through the Global Positioning System, without being dependent on foreign positioning, navigation, and timing services;
- Provide on a continuous, worldwide basis civil space-based, positioning, navigation, and timing services free of direct user fees for civil, commercial, and scientific uses, and for homeland security through the Global Positioning System and its augmentations, and provide open, free access to information necessary to develop and build equipment to use these services;

- Improve capabilities to deny hostile use of any space-based positioning, navigation, and timing services, without unduly disrupting civil and commercial access to civil positioning, navigation, and timing services outside an area of military operations, or for homeland security purposes;
- Improve the performance of space-based positioning, navigation, and timing services, including more robust resistance to interference for, and consistent with, U.S. and allied national security purposes, homeland security, and civil, commercial, and scientific users worldwide;
- Maintain the Global Positioning System as a component of multiple sectors of the U.S. Critical Infrastructure, consistent with Homeland Security Presidential Directive-7, Critical Infrastructure Identification, Prioritization, and Protection, dated December 17, 2003;
- Encourage foreign development of positioning, navigation, and timing services and systems based on the Global Positioning System. Seek to ensure that foreign space-based positioning, navigation, and timing systems are interoperable with the civil services of the Global Positioning System and its augmentations in order to benefit civil, commercial, and scientific users worldwide. At a minimum, seek to ensure that foreign systems are compatible with the Global Positioning System and its augmentations and address mutual security concerns with foreign providers to prevent hostile use of space-based positioning, navigation, and timing services; and
- Promote the use of U.S. space-based positioning, navigation, and timing services and capabilities for applications at the Federal, State, and local level, to the maximum practical extent.

IV. Management of Space-Based Positioning, Navigation, and Timing Services

This policy establishes a permanent National Space-Based Positioning, Navigation, and Timing Executive Committee. The Executive Committee will be co-chaired by the Deputy Secretaries of the Department of Defense and the Department of Transportation or by their designated representatives. Its members will include representatives at the equivalent level from the Departments of State, Commerce, and Homeland Security, the Joint Chiefs of Staff, the National Aeronautics and Space Administration, and from other Departments and Agencies as required. Components of the Executive Office of the President, including the Office of Management and Budget, the National Security Council staff, the Homeland Security Council staff, the Office of Science and Technology Policy, and the National Economic Council staff, shall participate as observers to the Executive Committee. The

Chairman of the Federal Communications Commission shall be invited to participate on the Executive Committee as a Liaison. The Executive Committee shall meet at least twice each year. The Secretaries of Defense and Transportation shall develop the procedures by which the Committee shall operate.

The Executive Committee shall make recommendations to its member Departments and Agencies, and to the President through the representatives of the Executive Office of the President. In addition, the Executive Committee will advise and coordinate with and among the Departments and Agencies responsible for the strategic decisions regarding policies, architectures, requirements, and resource allocation for maintaining and improving U.S. space-based positioning, navigation, and timing infrastructures, including the Global Positioning System, its augmentations, security for these services, and relationships with foreign positioning, navigation, and timing services. Specifically, the Executive Committee shall:

- Ensure that national security, homeland security, and civil requirements receive full and appropriate consideration in the decision-making process and facilitate the integration and deconfliction of these requirements for space-based positioning, navigation, and timing capabilities, as required;
- Coordinate individual Departments' and Agencies' positioning, navigation, and timing program plans, requirements, budgets, and policies, and assess the adequacy of funding and schedules to meet validated requirements in a timely manner;
- Ensure that the utility of civil services exceeds, or is at least equivalent to, those routinely provided by foreign space-based positioning, navigation, and timing services;
- Promote plans to modernize the U.S. space-based positioning, navigation, and timing infrastructure, including: (1) development, deployment, and operation of new and/or improved national security and public safety services when required and to the maximum practical extent; and (2) determining the apportionment of requirements between the Global Positioning System and its augmentations, including consideration of user equipment;
- Review proposals and provide recommendations to the Departments and Agencies for international cooperation, as well as spectrum management and protection issues; and
- Establish a space-based Positioning, Navigation, and Timing Advisory Board. The board shall be comprised of experts from outside the United States Government, and shall be chartered as Federal Advisory Committee.

The Executive Committee shall establish the National Space-Based Positioning, Navigation, and Timing Coordination Office. This office shall provide the staff functions for the Executive Committee. It shall be led by a full-time Director chosen by, and reporting to the Executive Committee, and shall include a cadre of full-time staff provided by Departments and Agencies represented on the Executive Committee. The Executive Committee shall determine the resources for the National Space-Based Positioning, Navigation, and Timing Coordination Office, including funding, location, staffing, and composition, consistent with the direction provided in Section VII of this policy.

The National Space-Based Positioning, Navigation, and Timing Coordination Office shall serve as the Secretariat for the Executive Committee and shall perform those functions delegated by the Executive Committee. Departments and Agencies shall provide appropriate information to the National Space-Based Positioning, Navigation, and Timing Coordination Office to ensure interagency transparency about positioning, navigation, and timing programs, policies, budgets, and activities that might affect mutual interests or interagency dependencies. The Interagency Global Positioning System Executive Board is hereby disestablished, and the Executive Committee or the National Space-Based Positioning, Navigation, and Timing Coordination Office, as appropriate, shall assume its functions as defined in the Positioning, Navigation, and Timing Executive Committee Charter, consistent with the direction provided in Section VII of this policy.

The Executive Committee shall advise and coordinate the interdepartmental resource allocation for the Global Positioning System and its augmentations on an annual basis. The Secretary of Defense shall have primary responsibility for providing resources for development, acquisition, operation, sustainment, and modernization of the Global Positioning System. The Secretary of Transportation shall provide resources to the Secretary of Defense for assessment, development, acquisition, implementation, operation, and sustainment of additional designated Global Positioning System civil capabilities beyond the second and third civil signals already contained in the current Global Positioning System program. Global Positioning System civil signal performance monitoring, augmentations, and other unique positioning, navigation, and timing capabilities will be funded by the agency or agencies requiring those services or capabilities, including out-year procurement and operations costs. Any new technical features proposed and funded by the civil agencies shall not degrade or displace existing or planned national security functions of the system. If the Executive Committee recommends that the availability of Global Positioning System capabilities should be accelerated, the Executive Committee will make recommendations regarding the resources required to accelerate those

capabilities. Resource issues will be resolved during the regular budget process

The details of the cost sharing between: (1) the Department of Defense and the Department of Transportation, for the Global Positioning System; and (2) Departments and Agencies sponsoring augmentations, and/or unique or accelerated capabilities, shall be outlined in a Five-Year National Space-Based Positioning, Navigation, and Timing Plan, consistent with the guidance provided in Section VII of this policy.

V. Foreign Access to U.S. Space-based Positioning, Navigation and Timing Capabilities

Any exports of U.S. positioning, navigation, and timing capabilities covered by the United States Munitions List or the Commerce Control List will continue to be licensed pursuant to the International Traffic in Arms Regulations or the Export Administration Regulations, as appropriate, and in accordance with all existing laws and regulations.

As a general guideline, export of civil or other non-United States Munitions List space-based positioning, navigation and timing capabilities that are currently available or are planned to be available in the global marketplace will continue to be considered favorably. Exports of sensitive or advanced positioning, navigation, and timing information, systems, technologies, and components will be considered on a case-by-case basis in accordance with existing laws and regulations, as well as relevant national security and foreign policy goals and considerations. In support of such reviews, the Secretary of State, in consultation with the Secretaries of Defense, Commerce, and Energy, the Administrator of the National Aeronautics and Space Administration, and the Director of Central Intelligence, shall modify and maintain the Sensitive Technology List directed in U.S. Commercial Remote Sensing Space Policy, dated April 25, 2003, including those technology items or areas deemed sensitive for positioning, navigation and timing applications. The Secretaries of State and Commerce shall use the list in the evaluation of requests for exports.

Agency Roles and Responsibilities

Departments and Agencies shall allocate the resources required to fulfill the objectives of this policy. Nothing in this policy shall diminish the operational and budgetary authorities of the Departments and Agencies.

Secretary of Defense shall:

- Have responsibility for development, acquisition, operation, security, and continued modernization of the Global Positioning

System, while facilitating appropriate civil and homeland security Department and Agency representation and participation in these activities, and any decisions that affect civil and homeland security equities;

- Develop, acquire, operate, realistically test, evaluate, and maintain navigation warfare capabilities and other capabilities required to:
- Effectively utilize the Global Positioning System services in the event of adversary jamming or other interference;
- Deny to adversaries position, navigation, and timing services from the Global Positioning System, its augmentations, and/or any other space-based position, navigation, and timing systems without unduly disrupting civil, commercial, and scientific uses of these services outside an area of military operations, or for homeland security purposes; and
- Identify, locate and mitigate, in coordination with Departments and Agencies, as appropriate, any interference on a global basis that adversely affects use of the Global Positioning System for military operations;
- Ensure the earliest operational availability for modernized military and navigation warfare capabilities;
- Train, equip, test, and exercise U.S. military forces and national security capabilities in operationally realistic conditions that include denial of the Global Positioning System. In cooperation with the Secretaries of Transportation and Homeland Security, and as appropriate, with the Secretary of State, develop guidelines that facilitate these activities and Navigation Warfare training, testing, demonstrations, and exercises without unduly disrupting or degrading homeland security and civil services and operations, either internationally or domestically;
- Promote use of Global Positioning System national security services to allied military forces to facilitate interoperability between U.S. and allied forces and capabilities, and to maintain their use as the pre-eminent military space-based positioning, navigation, and timing capability;
- Consistent with the guidance in Section V of this policy, make Global Positioning System national security services, user equipment, information, and technology available for use by allied military forces; and
- Work with allies to monitor access to national security services and user equipment, in order to limit the potential for

adversaries to use these capabilities against U.S. and allied military forces;

- Maintain the commitment to discontinue the use of the feature known as Selective Availability designed to degrade globally the Standard Positioning Service of the Global Positioning System;
- Facilitate access to appropriate levels of national security services and user equipment at the Federal level to meet critical requirements for emergency response and other homeland security purposes, and, on an exceptional basis, for civil purposes, including state or local emergency response;
- Develop improved, dedicated national security positioning, navigation, and timing capabilities, including but not limited to more diverse, flexible, and capable signals and services;
- Maintain lead responsibility for negotiating with foreign defense organizations any cooperation regarding access to or information about Global Positioning System military services; and
- In cooperation with other Departments and Agencies, assess the utility and feasibility of hosting secondary payloads on Global Positioning System satellites, including, but not limited to those intended to enhance global search and rescue capabilities for all users. No secondary payload may adversely affect the performance, schedule, or cost of the Global Positioning System, its signals or services. Resources required for the assessment, development, acquisition, integration, and operation of secondary payloads shall be the responsibility of the sponsoring agency or agencies.

The Secretary of Transportation shall:

- Have lead responsibility for the development of requirements for civil applications from all United States Government civil Departments and Agencies;
- Ensure, in cooperation with the Secretary of Defense and the Secretary of Homeland Security, the performance monitoring of U.S. civil space-based positioning, navigation, and timing services;
- Consistent with the guidance in Section V of this policy, and in coordination with the Secretary of Commerce and the Secretary of State, facilitate: (1) foreign development of civil positioning, navigation, and timing services and systems based on the Global Positioning System; and (2) international participation in the development of civil applications for U.S. space-based positioning, navigation, and timing services;

- Ensure, in coordination with the Secretary of Defense, that space-based positioning, navigation, and timing public safety services meet or exceed international performance standards, including but not limited to those used for these services in aviation and/or maritime applications;
- In cooperation with other Departments and Agencies, promote the use of U.S. civil space-based positioning, navigation, and timing services and capabilities for transportation safety;
- Represent the civil Departments and Agencies in the development, acquisition, management, and operations of the Global Positioning System;
- Develop, acquire, operate, and maintain Global Positioning System space or terrestrial augmentations for civil transportation applications;
- Ensure the earliest operational availability for modernized civil signals and services on the Global Positioning System and its augmentations, in coordination with the Secretary of Defense;
- In coordination with the Secretary of Homeland Security, develop, acquire, operate, and maintain backup position, navigation, and timing capabilities that can support critical transportation, homeland security, and other critical civil and commercial infrastructure applications within the United States, in the event of a disruption of the Global Positioning System or other space-based positioning, navigation, and timing services, consistent with Homeland Security Presidential Directive-7, Critical Infrastructure Identification, Prioritization, and Protection, dated December 17, 2003; and
- In cooperation with the Secretary of Defense, assess and assist, as appropriate, in the international acceptance for using the military positioning, navigation, and timing services of the Global Positioning System for operations in civil airspace.

The Secretary of Commerce shall:

- Represent U.S. commercial interests with other Departments and Agencies in the requirements review of the Global Positioning System and related space-based augmentations;
- In coordination with the Secretaries of State, Defense, and Transportation and the National Aeronautics and Space Administration, seek to protect the radio frequency spectrum used by the Global Positioning System and its augmentations through appropriate domestic and international spectrum management and regulatory practices;

- In coordination with the Secretaries of Defense and Transportation, and the Administrator of the National Aeronautics and Space Administration, facilitate cooperation between the United States Government and U.S. industry as appropriate to identify mutually acceptable solutions that will preserve existing and evolving uses of space-based positioning, navigation, and timing services, while allowing for the development of other technologies and services that depend on use of the radio frequency spectrum;

- In cooperation with the Administrator of the National Aeronautics and Space Administration, develop and provide to the Secretary of Transportation requirements for use of the Global Positioning System and its augmentations to support civil space systems; and

- In cooperation with other Departments and Agencies, promote the use of U.S. civil space-based positioning, navigation, and timing services and capabilities for applications at the Federal, State, and local level, to the maximum practical extent.

The Secretary of State shall:

- In cooperation with the Secretary of Defense, the Secretary of Transportation, and other Departments and Agencies promote the use of civil aspects of the Global Positioning System and its augmentation services and standards with foreign governments and other international organizations;

- Take the lead for negotiating with foreign governments and international organizations regarding civil and, as appropriate and in coordination with the Secretary of Defense, military positioning, navigation, and timing matters, including but not limited to coordinating interagency review of:

- Instructions to U.S. delegations for bilateral and multilateral consultations relating to the planning, management, and use of the Global Positioning System and related augmentation systems; and

- International agreements with foreign governments and international organizations regarding the planning, operation, management, and/or use of the Global Positioning System and its augmentations; and

- Modify and maintain, in coordination with the Secretaries of Defense, Commerce, and Energy, the Director of Central Intelligence, and the Administrator of the National Aeronautics and Space Administration, the Sensitive Technology List created by U.S. Commercial Remote Sensing Space Policy, dated April 25, 2003. In particular, include sensitive technology items and/or

information related to positioning, navigation, and timing applications.

The Secretary of Homeland Security shall:

- Identify space-based positioning, navigation, and timing requirements for homeland security purposes to the Secretary of Transportation, and coordinate the use of positioning, navigation, and timing capabilities and backup systems for homeland security purposes by Federal, State, and local governments and authorities;
- In coordination with the Secretary of Transportation, and with other Departments and Agencies, promote the use of the Global Positioning System positioning and timing standards for use by Federal agencies, and by State and local authorities responsible for public safety and emergency response;
- In coordination with the Secretary of Defense, and in cooperation with the Secretaries of Transportation and Commerce, ensure:
 - Mechanisms are in place to identify, understand, and disseminate timely information regarding threats associated with the potential hostile use of space-based positioning, navigation and timing services within the United States; and
 - Procedures are developed, implemented, and routinely exercised to request assistance from the Secretary of Defense should it become necessary to deny hostile use of space-based position, navigation and timing services within the United States;
- In coordination with the Secretaries of Defense, Transportation, and Commerce, develop and maintain capabilities, procedures, and techniques, and routinely exercise civil contingency responses to ensure continuity of operations in the event that access to the Global Positioning System is disrupted or denied;
- In coordination with the Secretaries of Transportation and Defense, and in cooperation with other Departments and Agencies, coordinate the use of existing and planned Federal capabilities to identify, locate, and attribute any interference within the United States that adversely affects use of the Global Positioning System and its augmentations for homeland security, civil, commercial, and scientific purposes; and
- In coordination with the Secretaries of Transportation and Defense, and the Director of Central Intelligence, and in cooperation with other Departments and Agencies: (1) develop a central repository and database for reports of domestic and

international interference to the civil services of the Global Positioning System and its augmentations for homeland security, civil, commercial, and scientific purposes; and (2) notify promptly the Administrator, National Telecommunications and Information Administration, the Chairman of the Federal Communications Commission, the Secretary of Defense, the Director of Central Intelligence, and other Departments and Agencies in cases of domestic or international interference with space-based positioning, navigation, and timing services to enable appropriate investigation, notification, and/or enforcement action.

The Administrator of the National Aeronautics and Space Administration, in cooperation with the Secretary of Commerce, shall develop and provide to the Secretary of Transportation requirements for the use of the Global Positioning System and its augmentations to support civil space systems.

The Director of Central Intelligence shall identify, monitor, and assess the development of foreign threats to the use of the Global Positioning System positioning, navigation, and timing architectures and related services; provide information to assist the Secretary of Defense in development of countermeasures.

Departments and Agencies detecting interference, or receiving reports of domestic or international interference adversely affecting the performance of U.S. space-based positioning, navigation, and timing services shall provide timely reports to the Secretary of Homeland Security, the Secretary of Defense, and the Director of Central Intelligence. Upon notification by the Secretary of Homeland Security:

- The Secretary of Commerce, in cooperation with other Departments and Agencies, and with the Chairman of the Federal Communications Commission shall take appropriate and legally permissible actions required to mitigate interference to U.S. space-based positioning, navigation, and timing services within the United States; and

- The Secretary of State shall, as appropriate, notify and/or coordinate the notification of foreign governments and international organizations in cases of interference with U.S. space-based positioning, navigation, and timing services caused by foreign government or commercial activities.

NON-PAPER SPACE-BASED POSITIONING, NAVIGATION, AND TIMING SYSTEMS

I. GPS

The primary system used throughout the world for space-based positioning, navigation, and timing is the Global Positioning System (GPS), a constellation of U.S. Government satellites providing continuous civil service free of direct user charges to an unlimited number of users for peaceful purposes. GPS is operated by the U.S. Air Force in support of critical military operations around the world. Additionally, GPS is critical to a wide range of civilian activities and represents a fundamental component of the global information infrastructure.

The GPS constellation, completed in 1995, consists of more than 24 satellites that circle the earth every 12 hours from an altitude of nearly 20,000 km. With four or more satellites in view, a GPS receiver can pinpoint its location anywhere on or above the surface of the Earth to within a few meters. Higher accuracy-within centimeters, or even millimeters-is often achieved by correcting the GPS signal with external augmentation systems.

GPS technology can be found in everything from cars and planes to cell phones and soda cans. It is being used to improve productivity in areas as diverse as farming, mining, construction, surveying, taxicab management, and package delivery. It is enhancing public safety by preventing transportation accidents and by reducing the response times of ambulances, firefighters, and other emergency services. GPS is also furthering scientific aims such as weather forecasting, earthquake prediction, and environmental protection. Furthermore, the precise GPS time signal, derived from atomic clocks, is being applied to critical economic activities such as synchronizing communication networks, managing power grids, and authenticating electronic transactions. This same technology, whether designed for military capabilities or not, provides inherent capabilities that can be used by adversaries, including enemy forces and terrorist groups. As such, the U.S. is committed to developing a range of capabilities to prevent potential hostile use of GPS services while protecting access to U.S./Allied national security services and preserving peaceful use of civil services outside an area of conflict.

Similar with the growth in civil and commercial applications, the positioning, navigation, and timing information provided by the Global Positioning System

remains critical to U.S. national security, and its applications are integrated into virtually every facet of U.S. military operations. U.S. and Allied military forces will continue to rely on the Global Positioning System military services for positioning, navigation, and timing services.

GPS currently provides two categories of service: the Standard Positioning Service, available free of charge to anyone in the world; and the Precise Positioning Service, available only to authorized U.S. and Allied military and select federal government users. Beginning in 2005, an additional civil signal and two new military signals will be incorporated into the constellation to increase overall system performance. In 2006, improvements will continue as satellites with a third civil signal will be launched into the constellation.

The United States and Europe recently agreed to establish interoperability and non-interference between GPS and Europe's planned Galileo satellite navigation system, as well as cooperation on a new civil signal that will be common to both systems. This is expected to further improve service for civilian users and accelerate the already healthy growth of the commercial satellite navigation market.

II AUGMENTATIONS

In order for satellite navigation technology to meet all the requirements of civilian users, the U.S. Government has implemented augmentation systems to improve the performance of standalone GPS. Many augmentations rely on a technique known as differential GPS and use reference stations that continuously monitor the GPS signals. Since the position of the reference station has been precisely surveyed, the errors in the satellite signals can be calculated and corrections broadcast to users in the area of coverage. The user's differential GPS receiver applies the correction message to improve the accuracy of its own position. The differential broadcast may also include integrity warnings for any satellite signals that should not be used. A few examples of Augmentations to GPS are detailed below.

III. Nationwide Differential Global Positioning System (NDGPS)

NDGPS is a ground-based augmentation that provides real-time enhancements to GPS, including integrity monitoring and accuracy improvements to enable advanced highway, rail, and maritime applications. Future

enhancements to the NDGPS, now in the final research and development stages, are planned to provide sub-meter accuracy.

The goal of NDGPS is to provide dual terrestrial coverage over the continental U.S. and portions of Alaska to support a wide range of navigation and positioning requirements at the federal and state levels, as well as fulfilling the needs of current and future commercial applications. NDGPS currently provides single coverage service over 87% of the continental U.S., Alaska, Hawaii, and Puerto Rico, and dual coverage over approximately 55% of the same area. Dual coverage provides improved system availability, and will increase the availability of the system from the current 99.7% to 99.99%. NDGPS is built to an international standard (ITU-R-M.823). Compatible systems have been installed in more than 40 countries, covering all of Japan, most of Europe, most coastal areas, and many inland areas of South America.

IV. Wide Area Augmentation System (WAAS)

WAAS, a space-based GPS augmentation system operated by the Federal Aviation Administration (FAA), provides increased accuracy, availability, and integrity for all phases of flight in the National Airspace System, including vertical guidance for precision approach applications. WAAS supports additional capabilities such as advanced (curved and segmented) arrival and departure procedures, parallel runway operations, missed approaches, vertical takeoffs, and enhanced surface movement operations.

WAAS was commissioned by the FAA in 2003 and is expected to attain full operational capability for single-frequency users in 2006. When the GPS third civil signal, L5, becomes available, dual-frequency WAAS users will achieve further performance improvements to include Category I precision approach. Although designed primarily for aviation users, WAAS is also widely available for use by other navigation user communities at the discretion of the appropriate operational authority.

Satellite-based augmentation systems (SBAS) similar to WAAS, but for other regions of the world are also being developed by Europe (European Geostationary Navigation Overlay System or EGNOS); Japan (Multi-functional Transport Satellite (MTSAT)-based Satellite Augmentation System or MSAS); and India ((GPS Aided Geo Augmented Navigation or GAGAN), and are being considered by additional nations such as Brazil.

. Local Area Augmentation System (LAAS)

LAAS is a ground-based GPS augmentation system (GBAS) being developed by the FAA that provides differential corrections to aviation users via a localized VHF data broadcast. LAAS is expected to provide the required accuracy, availability, integrity, and continuity to initially support Category I precision approaches and eventually Category II and III precision approaches at LAAS-equipped airfields. The LAAS program is currently in the research and development phase.

Australia is also developing a GBAS for aviation use known as the Ground-based Regional Augmentation System (GRAS). It is a regional system that uses a distributed network of reference stations for monitoring GPS, and a central processing facility for computing GPS integrity and differential correction information. The information is sent to a network of terrestrial stations for a local check and reformatting. Each site transmits a VHF Data Broadcast (VDB) signal.

VI. Continuously Operating Reference Station (CORS) Network

The CORS program, managed by the National Geodetic Survey, comprises a nationwide network of permanently operating Global Positioning System (GPS) receivers supporting non-navigation, post-processing applications by providing users with ties to the National Spatial Reference System for accurate, 3-dimensional positioning. Typical uses of CORS include land management, coastal monitoring, civil engineering, boundary determination, mapping, and geographical information systems, geophysical and infrastructure monitoring, as well as future improvements to weather prediction and climate monitoring. The CORS program is a multi-purpose cooperative endeavor involving more than 130 government, academic, and private organizations--each of which operates at least one site. In particular, it includes all existing NDGPS sites and all existing FAA WAAS sites.

VII ADDITIONAL GLOBAL AND REGIONAL SYSTEMS

Galileo

The Galileo satellite navigation program is a joint initiative between the European Union and the European Space Agency to build and operate a 30-satellite constellation that provides similar capabilities to GPS, but as a commercially-operated, for-profit venture, not a public good. The system will offer four distinct

positioning, navigation, and timing services and one search and rescue service.

- An "Open Service" with open access signals that is free of user charges.
- A "Safety of Life Service" will be a "guaranteed" service that provides integrity warnings to users when the system fails to meet certain accuracy requirements.
- A "Commercial Service" that is envisaged to include service guarantees and a limited broadcasting capacity for messages from service centers to users.
- A "Public Regulated Service" will be a secured (encrypted) service for authorized governmental users (police, fire, emergency response, etc.).
- A "Search and Rescue Service" will transmit the alert messages received from distress emitting beacons as a contributor to enhancing the performance of the international COSPAS-SARSAT Search and Rescue system.

GLONASS

GLONASS is a Russian space-based navigation system comparable to the U.S. GPS system. The fully operational system will contain 21 satellites in 3 orbital planes, with 3 on-orbit spares. The GLONASS system is managed for the Russian Federation Government by the Russian Space Forces providing benefits to civil users through a variety of applications. The GLONASS system has two types of navigation signals: standard precision navigation signal (SP) and high precision navigation signal (HP). SP positioning and timing services are available to all GLONASS civil users on a continuous, worldwide basis. On December 10, 2003, three GLONASS spacecraft were placed into orbit in Plane 1, including one of the new generation of GLONASS-M satellites. The addition of these three satellites will bring the GLONASS constellation to a total of 11 operational satellites.

QZSS

The Quasi-Zenith Satellite System [Jun-Ten-Cho in Japanese] is a constellation of at least three satellites, configured such that one of them is always positioned at a high elevation angle over Japan. RF transmission will not be obstructed by tall buildings or mountains, because one of satellites will always remain near high in the sky over Japan at all times. As a result, signal degradation caused by building blockage and multiple signal paths will

be less frequent, making the whole system ideal and reliable for mobile data communication and broadcasting. The system is also expected to increase accuracy to GPS users in the eastern Asia area. The service, planned for 2008, can be augmented with the geostationary satellites in Japan's MSAS, currently under development.

Beidou

Although China has not yet established an operational satellite navigation and positioning network, research for such a system has been underway for many years, and a future space-based navigation capability is an acknowledged goal. Beidou ('Big Dipper') is the satellite component for the independent Chinese satellite navigation and positioning system. The Beidou satellite navigation and positioning system consists of two satellites in geosynchronous orbit. The final Beidou constellation will include four satellites, two operational and two backups. Together with the ground stations, the Beidou system will provide navigation and positioning signals covering the East Asia region. However, to provide global signal coverage, satellites flying in other orbits around the world must complement the system. Three satellites have been launched to date.